MAINTENANCE ASAP PROGRAMS: BARRIERS AND OPPORTUNITIES

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Aviation Safety Action Programs (ASAPs) in aviation maintenance organizations offer aviation maintenance technicians the mechanisms to report errors without a fear of retribution and contribute toward the development of a safer air transport system. Although the number of maintenance ASAP programs has more than doubled in the past two years, the key barriers of interpersonal trust and awareness continue to restrict the full potential of these programs. While some organizations continue to struggle with these barriers and are unable to implement an ASAP program, others are striving to increase the number of sole-source reports by increasing the awareness about ASAP programs among their stakeholders and also building industry-wide support groups to develop a stronger networking mechanism that would ultimately advance the entire industry's safety culture. As these efforts continue to progress, unique opportunities for collaboration and data mining are arising. This report presents an analysis of the two key barriers and presents a preview at how contemporary text analysis systems could be used to expand the overall value of the data collected by ASAP programs.

INTRODUCTION

Aviation Safety Action Programs (ASAPs) are specific error reporting programs designed to encourage mechanics, pilots, dispatchers, and flight attendants to report their errors through their respective ASAP programs. Each company needs to have its own ASAP agreement with the Federal Aviation Administration (FAA), and each agreement is specific to either the maintenance, flight, dispatch, or flight attendant group. While these programs are generally accepted as effective mechanisms for identifying and resolving systemic issues, different groups have their own unique challenges and therefore differ in the nature of their participation. For example, as of September 1, 2005, there were 45 flight ASAP programs, 21 maintenance and engineering ASAP programs, 20 dispatch ASAP programs, and 5 flight attendant ASAP programs (http://www.faa.gov/safety/programs_initiatives/ aircraft_aviation/asap/participants/). Also, flight ASAP programs tend to have about ten times as many reports as the maintenance programs do. Therefore, the effectiveness of the overall ASAP program should not be measured by the number of reports alone. Patankar and Driscoll (2005) define a successful maintenance ASAP program as,

> "the one that has matured to such a level that there is a regular flow of ASAP reports, there are personnel dedicated to maintaining, analyzing, and implementing these reports, and there is a mechanism established to provide feedback regarding the overall effects or impacts of the ASAP program."

Patankar and Driscoll (2005) also noted that maintenance ASAP programs tend to be "networked" while flight ASAP programs tend to be "linear." Therefore, the investigation of maintenance ASAP reports is a lot more complex and time-consuming task than that of flight ASAP programs.

The overall goal of this research project is to identify the key barriers to successful maintenance ASAP programs and to

document the best practices from certain ongoing ASAP programs that may be of value to other fledgling programs.

In the first phase of this research, reported by Patankar and Driscoll (2005), a survey questionnaire was developed to identify the key success/failure factors. Over 5,000 maintenance personnel responded to the survey. Based on this survey, the factors that tend contribute toward a successful ASAP program in aviation maintenance organizations are as follows:

- There is a significantly <u>higher</u> level of trust between mechanics and their supervisors
- End-users perceive ASAP programs to be very valuable in improving the overall safety of the industry
- Good communication about the ASAP program and a standardized or a well-understood report handling process exists

Based on the same survey, factors that contribute toward the failure of an ASAP program in aviation maintenance organizations are as follows:

- There is a significantly <u>lower</u> level of trust between mechanics and their supervisors
- End-users don't seem to see a significant benefit in having an ASAP program—it is likely that they are satisfied with their internal error/hazard reporting program
- There is a severe lack of awareness about ASAP programs

In the second phase of this research, emphasis was placed on (a) seeking a qualitative or descriptive clarification regarding the barriers for maintenance ASAP programs and (b) testing the applicability of computerized text analysis systems to enhance the overall analytical capabilities.

LITERATURE REVIEW

This literature review focuses on two areas: (a) the value of interpersonal trust and awareness of ASAP program and (b) issues germane to the investigative challenges of qualitative reports and structured error classification schemes.

Interpersonal Trust and Awareness of ASAP Programs: The two broad challenges discovered through the survey research in the first phase of this project were lack of interpersonal trust and lack of awareness about maintenance ASAP programs.

Many research studies have identified interpersonal trust as a critical and essential factor in proactive error management programs (cf. Taylor & Christensen, 1998; Taylor & Thomas, 2003; Patankar & Taylor, 2004; Patankar, Taylor, & Goglia, 2002; Patankar & Taylor, In Press). While it is widely acknowledged that trust is essential, it is also perceived that "trust is hardest to establish when you need it the most" (Duck, 1998 p. 69). Therefore, it is important to understand the specific actions or inactions that might contribute toward a positive or a negative effect on the overall trust scale.

The Interpersonal Trust Scale: The interpersonal trust scale has emerged as one of the most significant measures during the course of multiple longitudinal studies that measured the effectiveness of Maintenance Resource Management (MRM) programs (cf. Taylor & Christensen, 1998; Taylor & Thomas, 2003; Patankar & Taylor, 2004; and Patankar & Taylor, In Press). Based on these studies, it is known that there is a wide variation in such trust among the various maintenance organizations—interpersonal trust tends to be higher in smaller organizations and military units and lower among larger organizations—the range of trust values seem to indicate that up to a third of the mechanics don't tend to trust that their supervisors will act in the interest of safety. Patankar and Driscoll (2005) not

only confirmed that finding across a national sample of over 5,000 maintenance personnel, but also discovered that the mechanic-management trust in companies with ASAP programs was significantly higher than those without ASAP programs.

The questionnaire items that constitute the trust scale—both in the MRM/TOQ (Taylor & Thomas, 2003) and in the Maintenance ASAP Questionnaire (Patankar & Driscoll, 2005) are as follows:

- My supervisor can be trusted
- My safety ideas would be acted on if reported to supervisor
- My supervisor protects confidential information
- I know proper channels to report safety issues

Lack of Awareness: A lack of awareness regarding the ASAP program is not just a public relations issue, but it is a matter of intentionally educating the stakeholders in the value, application, and overall significance of the program. The literature on intentional education of the stakeholders is limited; however, experience from MRM research indicates that a general awareness training program has been successful in informing the stakeholders of the relevance and value of the MRM program, in developing a common language that incorporates the key terminology and builds a shared understanding or mental model, and in involving the stakeholders in identifying key issues that need to be addressed for the program to take hold and mature to a higher level of acceptance and development (Taylor & Christensen, 1998; Patankar & Taylor, 2004).

Knowledge regarding maintenance ASAP programs seems to have spread mostly by people who were interested in developing such programs rather than a coordinated effort to educate the stakeholders. Since labor unions tend to represent technicians from multiple organizations, they serve as a valuable conduit for transfer of best practices across organizational boundaries (Taylor & Christensen, 1998; Patankar & Taylor, 2004). Additionally, the FAA offers a training course on ASAP for its inspectors and has also published and Advisory Circular (AC-120-66B). Key people in the industry have used these resources to develop the ASAP programs for their respective companies; however, there is no evidence of a formal training program in any of the companies. Some companies have started to incorporate ASAP fundamentals in their existing MRM training program. While this is an effective means to raise the awareness, it is not widespread. One other company has used the "traveling road show" approach to have their Event Review Committee (ERC) go to various line and base maintenance stations to discuss the ASAP program face-to-face with the mechanics. They report that this approach has resulted in a significant increase in their sole-source reports (Patankar & Gomez, 2005).

Another mechanism that is starting to gain some momentum is the Maintenance and Engineering Subcommittee of the industry-wide ASAP/FOQA Aviation Rulemaking Committee. The maintenance subcommittee was formed in October 2004. Since then, the committee has started to gain increasing visibility and interest. Its membership is increasing and it is shaping an agenda that will not only raise the awareness of maintenance-specific ASAP issues, but also assist in building maintenance-specific error classification schemes that could be mapped with the overall industry's Voluntary Aviation Safety Information-Sharing Process (VASIP).

Qualitative Reports Analysis: Challenges and Opportunities: Typical ASAP reports tend to be narrative text data. Such reports

are submitted to the program manager and then either the manager or the analyst codes the report using a structured coding scheme such as Boeing's Maintenance Error Decision Aid (MEDA) (Rankin & Allen, 1996) or an internal version that incorporates some additional fields that are important to that company. The prevalent analysis technique seems to be limited to the use of a structured classification system to code the incoming reports and to the presentation of its results in the form of bar charts or frequency tables (Patankar, 2005).

The flight ASAP community is developing VASIP, a data-sharing model that will allow multiple companies to share their ASAP reports. In order for such a system to work, the data classification schemes need to be compatible. Researchers from NASA and University of Texas researchers engaged in a project to develop a mapping system that would allow the partner companies to use their existing classification systems by translating the coding scheme to enable meaningful comparison across the companies (Chidester, Harper, & Patankar, 2005).

The maintenance community now has the unique opportunity to develop a common classification system that would not only map across the partner companies for maintenance ASAP reports, but also connect with the flight ASAP programs and enable cross-domain data mining (Chidester, Harper, & Patankar, 2005).

METHODOLOGY

In this research, emphasis was placed on (a) seeking a qualitative or descriptive clarification regarding the barriers and opportunities for maintenance ASAP programs and (b) testing the applicability of computerized text analysis systems to enhance the overall analytical capabilities.

Qualitative or Descriptive Clarification Regarding Barriers and Opportunities: Prior phase of this research indicated that the two main barriers to implementing a successful ASAP program in aviation maintenance organizations were lack of interpersonal trust and lack of awareness.

An information sharing meeting was organized at Saint Louis University to inform airlines, repair stations, and FAA inspectors about ASAP programs and to solicit their feedback based on their experiences with either trying to get an ASAP program approved or in running the already approved program. This was an open discussion and its results are presented in the results sections of this report.

Computerized Text Analysis Systems: One hundred ASAP reports were analyzed using a commercial off-the-shelf text-analysis tool called LexiQuest. This tool enables the analyst to submit narrative text reports and it analyzes these reports to identify related concepts. The analyst can then choose specific relationships for further investigation. This was an exploratory study to determine the potential applicability of such a system in the analysis of ASAP reports.

RESULTS

Discussion on Barriers to ASAP Programs: A group of 30 individuals from airlines, repair stations, FAA Certificate Management Offices, labor unions, and FAA Headquarters participated in this discussion.

This group was asked to describe the specific barriers they faced in implementing ASAP programs. After the presentation of several specific examples and personal experiences, the following general results emerged:

- Corporate disciplinary policies that conflict with the intent and spirit of ASAP programs tend to stall ASAP agreements. If companies could adopt ASAP-friendly disciplinary policies, the number of ASAP agreements would increase. Labor unions are willing to negotiate a language that protects honest mistakes and penalizes intentional disregard to safety.
- Blame culture in the maintenance environment, coupled with lack of trust between the management, labor groups, and the local FAA inspectors, is a bigger barrier than the corporate disciplinary policy. This blame culture is exacerbated by variances in the awareness of both the intent as well as the value of an ASAP program in the three groups.

The following points were also expressed to further clarify:
- Company discipline, in general, is not an FAA issue. The standard language recommended in the ASAP MOU template is that information obtained exclusively from ASAP investigations will not be used by the company or the FAA.
- If the company obtains information from other sources and there is an associated ASAP report, then the company should extend similar disciplinary protection to the reporter—this is not in the ASAP policy. According to the policy, the company can use non-sole source information, obtained outside the ASAP process, for disciplinary action. This is where interpersonal trust, labor-management relationships, and past experience with confidential information play a significant role.
- When one ASAP ERC discussed their program with personnel from base and line maintenance, top management, and their human resources department, they discovered that most people did not know much about the ASAP program. Now, they communicate with everyone regularly and the acceptance of the program is growing.
- The ASAP program is more important than the individual issue [of disciplining] and excessive or disciplinary action in the rarest of cases would threaten the program all together; it could collapse; it's all trust.
- As instances of actual changes made as a result of this program become more visible, the overall awareness and acceptance of this program will grow.

In summary, the trust and awareness issues are connected. Because some people are not fully aware of the intent, protocol, value, and effects of an ASAP program, there are some misconceptions about it in the industry. These misconceptions are compounded by the deeply routed blame culture which tends to focus on applying corporate disciplinary policies to punish the individual(s) who committed the error rather than addressing the systemic issues.

Computerized Text Analysis Systems: In order to test the capability of LexiQuest as a text-analysis system, 100 ASAP reports were used to explore some additional ways in which such data could be analyzed.

Generally, a text-analysis system detects unique concepts expressed in the narrative text—these concepts could be words or phrases. Then, the system groups these concepts based on their statistical relationship or proximity.

In this sample, the word "aircraft" appeared 65 times, the word 'maintenance" appeared 28 times and the word "logbook" appeared 19 times. Such listing of how often a word appears in the dataset provides a perspective on which concepts may be mentioned more frequently than others.

Granted, just because a concept is mentioned more frequently does not mean that it is more important to explore. The fact that aircraft is mentioned 65 times is a case in point. So, we focused on the concept "logbook," which was mentioned 19 times and had nine other concepts associated/linked with it.

Figure 1 is called "Concept Map." It presents a network of concepts that are linked to each other. The farther we go from the core concept, the weaker the connection among those concepts. That means concepts in the first arc appear more frequently near "Logbook;" concepts in the second arc appear less frequently near "Logbook;" and the concepts in the third arc appear even less frequently near "Logbook."
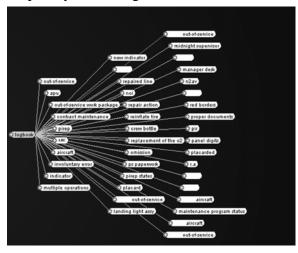

Figure 1: Concept map for the term "Logbook"

It is important to note that less frequently linked concepts or deeply buried concepts could be mined or "excavated" to identify "low-frequency---high-consequence" events. These are the events that occur less frequently or rarely, but could have a high-consequence. Typically, these events are lumped into the "other" category by structured classification systems. Also,

these links are buried so deep in the narratives that it is likely to completely miss the relevance of such links. For example, in the case of logbook errors, typically, one would respond to such errors by simply adding a training course, especially when there is a deep, but valid link between "Logbook" and "Improper Logbook Training." As we drilled deeper to identify additional concepts that may be linked with "Logbook," we discovered that that "Improper Logbook Training" was linked with "Logbook," "Contract Maintenance," and "PIREP."

In this sample, it seems that logbook errors are related to contract maintenance. So, prior to determining what type of training may be required, it would be important to understand what is needed and where it is needed.

In summary, there are two types of analysis systems: static and dynamic. The MEDA-type system is a static system and the text analysis system is a dynamic system. Both systems are complementary to each other and could enhance each other's effectiveness. A static system could be used to keep track of the overall trends in maintenance errors and the effects of specific interventions; whereas, a dynamic system could be used to drill-down to specific low-frequency---high-consequence events that are difficult to detect otherwise.

Significance of the Results: Generally, this project is making a significant contribution toward facilitating the transfer of best practices across the various maintenance ASAP programs through information-sharing meetings. Such efforts of this project will result in a more cohesive feedback to the FAA from the maintenance community. For example, some key changes to the current AC 120-66B are being considered by the ASAP Maintenance Subcommittee.

Similarly, this research project is playing a key role in preparing the maintenance community to participate in the industry-wide VASIP program. Efforts are underway to take the knowledge of text analysis systems and build a consistent error classification scheme for the maintenance community that incorporates both structured as well as unstructured data analysis. These efforts will prepare the maintenance community to realize full benefits of the VASIP program.

CONCLUSIONS

First, interpersonal trust and awareness are related. Therefore, industry groups such as the Maintenance and Engineering subcommittee and appropriate labor organizations could make a significant contribution toward raising the awareness of maintenance-specific issues and enabling the transfer of best practices across organizational boundaries. As the awareness of the value and effects of an ASAP program increases, the trust in this program as well as among the people in charge of such a program is bound to increase.

Second, initial tests of the text analysis system indicate that such analysis could uncover deeply hidden systemic hazards that would not be detectable by the conventional error classification systems. A hybrid system that incorporates the advantages of both structured as well as unstructured techniques would be invaluable.

ACKNOWLEDGMENTS

REFERENCES

1. Duck, J. (1998). Managing change: The art of balancing. In *Harvard Business Review on Change*, pp. 55-81. Boston: Harvard Business School Press.

2. Chidester, T., Harper, M., & Patankar, M. (2005). *Incorporating Maintenance and other groups into DNAA*. Presented at the FAA ASAP/FOQA ARC Meeting, Houston, TX, August 10.

3. Patankar, M. (2005). Analysis of Maintenance ASAP Reports. In *Proceedings of the Aircraft Maintenance and Human Factors Symposium & Workshop*, [CD-ROM], Society of Automotive Engineers, Arlington, TX, May 17-18.

4. Patankar, M. Driscoll, D. (2005). Factors affecting the success or failure of Aviation Safety Action Programs in aviation maintenance organizations. In *Aviation Maintenance Human Factors Program Review FY04,* p.9-14. Available at http://www.hf.faa.gov/docs/508/docs/AvMaint04.pdf

5. Patankar, M., & Gomez, M. (2005). *Proceedings of the Maintenance ASAP InfoShare Working Group Meeting*, St. Louis, MO, June 27 & 28, 2005. Saint Louis University.

6. Patankar, M.S., & Taylor, J.C. (2004). *Risk management and error reduction in aviation maintenance*. Aldershot, UK: Ashgate Publishing, Ltd.

7. Patankar, M., & Taylor, J. (In Press). MRM training, evaluation, and safety management. *Special Issue of the International Journal of Aviation Psychology—Maintenance Human Factors.*

8. Patankar, M., Taylor, J., & Goglia, J. (2002). Individual professionalism and mutual trust are key to minimizing the probability of maintenance errors. In *Proceedings of the Aviation Safety & Security Symposium*, April 17 & 18, Washington, D.C.

9. Rankin, B., and Allen, J. (1996, April-June). Boeing introduces MEDA, Maintenance Error Decision Aid, *Airline*r, 20-27.

10. Taylor, J. & Christensen, T. (1998). Airline Maintenance Resource Management. Warrendale, PA: Society of Automotive Engineers.

11. Taylor, J. & Thomas, R. (2003). Toward measuring safety culture in aviation maintenance: The structure of trust and professionalism. *International Journal of Aviation Psychology*. Vol 13(4), 321-343. Lawrence Erlbaum, US.